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Circular No. 808

May 1949 • Washington, D.C.

UNITED STATES DEPARTMENT OF AGRICULTURE



Grazing Spring-Fall Sheep Ranges of Southern Idaho

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CONTENTS

	Page		Page
The spring-fall ranges of southern Idaho.....	2	Recognizing range trend—Con.	
Recognizing the relative productivity of the range.....	3	Sagebrush with an understory chiefly of annual grasses and weeds.....	12
Sagebrush with a good understory of perennial grasses and weeds.....	4	Range with sagebrush replaced by cheatgrass or annual weeds (managed for return of perennials).....	13
Sagebrush with a sparse understory of perennial grasses.....	5	Maintaining or improving range condition.....	13
Sagebrush with an understory chiefly of annual grasses and weeds.....	7	When the range should be grazed in spring.....	14
Range with sagebrush replaced by cheatgrass or annual weeds.....	8	How many sheep should be grazed.....	17
Recognizing range trend.....	10	Grazing systems to use....	24
Sagebrush with a good understory of perennial grasses and weeds.....	11	Other practices that aid range improvement.....	29
Sagebrush with a sparse understory of perennial grasses.....	11	Checking grazing management and making adjustments.....	32
		Common and scientific names of species mentioned.....	34

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THE SPRING-FALL RANGES OF SOUTHERN IDAHO

Range sheepmen and range administrators are vitally interested in grazing the spring-fall ranges of southern Idaho in a manner that will provide the greatest returns without injuring the soil and vegetation. This keen interest arises from the fact that these ranges provide forage for 700,000 to 900,000 sheep during two highly important periods in a range sheep operation—the spring and the fall.

Most of the 18 to 20 million acres of spring-fall range in southern Idaho are covered by the sagebrush-grass vegetation type. The spring-fall ranges of this type lie largely on the Snake River Plains, in a roughly crescent-shaped belt along the Snake River from the Wyoming to the Oregon State lines. Some of them lie also in adjacent tributary valleys. They are generally located between the winter feed-lot areas in the irrigated section and the mountainous range lands used for summer grazing.

Sheep graze these ranges for several weeks in the spring during and following lambing. At that time, the ewes need palatable, highly digestible, nutritious young grasses and weeds to keep up their flow of milk. Lambs, too, require tender and succulent forage. Then in the fall sheep again use many of these ranges during and after breeding. Consequently, forage production on these spring-fall ranges directly influences the percentage lamb crop, the size of lambs and condition of ewes sent to summer range, and the wool production.

Plant growth on the spring-fall ranges begins early (March 1 to 15 on the lower Snake River Plains to April 10 on the upper Plains). The ranges are generally ready for grazing within 2 or 3 weeks after growth starts. They are grazed for 4 to 8 weeks until the grasses and weeds begin to dry. As the forage dries it loses much of its nutritive value. Sheep are then moved to mountainous summer ranges where they can obtain succulent forage. The drying forage on well-managed spring-fall ranges cures rather well in the usual absence of summer rains, and, together with any new green growth made as a result of fall rains, provides a fairly satisfactory ration for sheep during the fall before they go to the winter feed lot.

The characteristics that make well-managed spring-fall ranges desirable for sheep grazing are: (1) Abundant production of palatable and nutritious forage for ewes and lambs from early spring until summer ranges are ready for grazing, (2) availability of satisfactory forage for ewes in fall, (3) reliable forage production in years of favorable and unfavorable weather alike, and (4) relatively open stands of sagebrush that permit easy sheep movement over the range.

Many spring-fall ranges in southern Idaho have not maintained these desirable properties. Over the years they have suffered from too heavy grazing, too early grazing, uncontrolled burning, or plowing for cultivation and subsequent abandonment. Depending upon the kind of use and management they have received in the past, these ranges have deteriorated in various degrees; some only slightly, others have little of their original value left. Deterioration is continuing on some ranges. On others, as a result of better use and management,

the downward trend has been stopped and restoration to a more desirable productive condition has begun.

Ranges that are highly productive can be maintained, and deteriorated ranges can be restored by following a three-step program. The essentials of this program are:

1. Judge whether the relative range productivity is increasing or decreasing.
2. Prepare and carry out a grazing program that is based on this judgment.
3. Check each year to see whether grazing use is satisfactory. Make prompt adjustments when needed to correct for unsatisfactory use.

This publication is designed as a guide to assist the user and the administrator of sagebrush-grass sheep range in carrying out these three steps. It is based on practical experience, observation, and detailed experimental evidence secured through 20 years of study by the Forest Service in cooperation with the Bureau of Animal Industry at or near the United States Sheep Experiment Station, Dubois, Idaho. While the principles here outlined are specifically applicable to southern Idaho, the more general ones should apply on most sagebrush-grass ranges that are being used for spring-fall sheep grazing throughout the West.

RECOGNIZING THE RELATIVE PRODUCTIVITY OF THE RANGE

In order to make efficient plans for use of each part of the range, it is necessary to recognize the present state of health or relative productivity of the vegetation and soil. Productivity or condition may be judged by such characteristics as the relative vigor and abundance of good and poor forage plants, the quality of the soil, and the extent and degree of soil erosion. Four broad productivity situations can be readily recognized on spring-fall ranges. First, sagebrush ranges with a good understory of perennial grasses and weeds—ranges that produce abundant usable forage and have stable, well-protected soils—are in satisfactory condition. The other three situations represent ranges in unsatisfactory condition and include: Sagebrush with a sparse understory of perennial grasses, sagebrush with principally annual grasses and weeds in the understory; and ranges on which the original vegetation has been almost completely replaced by annual grasses or weeds.

These four situations on spring-fall range cannot be sharply separated. The three deteriorated groups merge into one another and overlap in such factors as density and composition of the vegetation and in forage production. This is because of the rather wide variation within each, not only between the different precipitation zones in different parts of the southern Idaho spring-fall range, but even within the same precipitation zone. For the purpose of planning better management ranges may be classified and described according to their vegetal characteristics as follows:

SAGEBRUSH WITH A GOOD UNDERSTORY OF PERENNIAL GRASSES AND WEEDS

On sagebrush range with a good understory of perennial grasses and weeds the original plant cover has not been seriously changed since settlement, and the ranges are producing from two-thirds to all the usable forage they are capable of producing (fig. 1). Half



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FIGURE 1.—Sagebrush range with a good understory of perennial grasses and weeds. The relatively open stand of sagebrush and the good stand of palatable perennial grasses and weeds in the openings between sagebrush plants (inset) provide an abundance of accessible forage.

to three-fourths of the grass and weed herbage is accessible and available to sheep. Year after year the rich mixture of perennial grasses, weeds, and palatable shrubs provides a dependable supply of high-quality forage. Ranges having such productivity are normally classed as in good to excellent condition.

In the understory are such palatable perennial grasses as bluebunch wheatgrass, bluestem wheatgrass, Sandberg and Nevada bluegrasses, needlegrasses, Indian ricegrass, and such palatable perennial weeds as balsamroots, lupines, tapertip hawksbeard, and royal penstemon. These palatable forage plants make up more than one-third of the total plant cover and are abundant in the spaces between sagebrush plants. They do not, however, form a solid cover. Areas of

bare ground between the grass and weed clumps are to be expected even on ranges in the best condition. Big or threetip sagebrush make up less than one-half the plant cover and form scattered to open stands that generally are fairly easy to walk through. Often bitterbrush and rarely mountain snowberry are abundant. Annual grasses and weeds are present in abundance only in years of high spring or fall precipitation.

Generally the soil is well preserved, essentially unchanged from primeval conditions. Sheet and gully erosion are not usually observable.

Maintenance or improvement of surface soil and forage cover on such ranges may usually be achieved by good grazing management. The reward for so doing is continued stability with an increase in grazing capacity on ranges that are not fully productive.

SAGEBRUSH WITH A SPARSE UNDERSTORY OF PERENNIAL GRASSES

When the understory of perennial grasses on the range has been reduced to a scattered stand, sagebrush has greatly thickened and there is an almost complete lack of perennial weeds (fig. 2). Sage-



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FIGURE 2.—Sagebrush with a sparse understory of perennial grasses. The dense stand of sagebrush makes utilization by sheep difficult. Hardly any perennial weeds are present, and the scattered understory of perennial grasses provides very little forage.

brush may form from one-half to nine-tenths of the plant cover. Frequently sagebrush is so dense that it is difficult to walk through, and tends to protect the few existing plants of perennial grasses and weeds from being grazed. Openings between sagebrush plants are small and nearly devoid of any palatable perennial plant cover. Annual grasses and weeds generally do not make up much of an understory.

Accelerated sheet and gully erosion are often severe. Openings between sagebrush plants may have suffered extensive soil losses. If this has occurred, there may be a surface layer of small pebbles and rocks (erosion pavement), the soil is lighter in color, and is 2 to 8 inches lower than that beneath sagebrush. Crowns of any perennial grass clumps in the openings between sagebrush plants are often conspicuously pedestaled, showing removal of surface soil from around them. In many individual places, however, such as level sites or where the land has been cultivated and abandoned, the soil may be but little damaged and relatively in much better condition than the forage cover.

The plant cover and soil have been damaged by improper grazing practices, sometimes combined with haphazard burning at intervals of several years, or by temporary cultivation. When so deteriorated, ranges often produce only one-twentieth as much forage as they could ultimately produce under proper management. Ranges with such low productivity are normally classed as in poor or very poor condition.

The great abundance of sagebrush is detrimental. Because of its extreme density, one-half to three-fourths of the small amount of herbage produced is unavailable for sheep grazing, losses of wool from snagging on the brush are great, lamb losses from straying and predators are high, and the grazing of sheep is very difficult and often unprofitable.

Maintenance and a slow increase of the better forage plants on sagebrush ranges with only a sparse understory of perennial grasses will be greatly aided by good grazing management, but any fairly rapid increase can come only after sagebrush removal. In most cases, moreover, perennial grass cover is too sparse to provide for natural revegetation, and sagebrush removal must be accompanied by range reseeded. Information on how to eradicate the sagebrush, and where to reseed, what species to use, and how to plant is given in several Federal and State publications pertaining to southern Idaho.³

The reward for improving this class of range is high. If soil erosion has not been too severe, it may be possible to increase forage production as much as 5 to 20 times. With a material reduction of sagebrush, movement of sheep will be made much easier and the losses of wool and lambs decreased or eliminated.

On ranges where the sagebrush has become dense but where the perennial grasses and weeds have not declined so severely, grazing management following sagebrush removal permits a gradual increase in palatable grasses and other good forage plants.

³ HULL, A. C., JR. REGRASSING SOUTHERN IDAHO RANGE LANDS. Idaho Agr. Col. Ext. Bul. 146. 7 pp. 1944.

PECHANEC, JOSEPH F., PLUMMER, A. PERRY, ROBERTSON, JOSEPH H., AND HULL, A. C., JR. ERADICATION OF BIG SAGEBRUSH (*Artemisia tridentata*). Res. Paper No. 10. Intermountain Forest and Range Expt. Sta. 23 pp. 1944. (Processed.)

Removal of sagebrush by planned burning can give good results,⁴ but haphazard burning is often disastrous. Precautions should be taken to prevent the escape of fire, and burning should be done only where the soils are not easily eroded and in the late summer or early fall when the period of extreme hazard is past and seed of good native grasses has shattered. Ranges must be carefully managed after burning. Where there are not sufficient good forage plants in the understory to provide a satisfactory forage cover, reseeding to adapted species should follow burning.

SAGEBRUSH WITH AN UNDERSTORY CHIEFLY OF ANNUAL GRASSES AND WEEDS

Sagebrush ranges of this group have a dense or fairly dense stand of sagebrush and an understory of annual grasses and weeds such as cheatgrass, fescues, tumblemustard, tansymustards, and Russian-thistle (fig. 3). Very scattered stands of perennial grasses such as



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FIGURE 3.—Sagebrush with annual grass and weed understory. The dense stand of sagebrush interferes with the use of the area by sheep. A sparse understory composed primarily of annuals provides little forage. In the detail picture, note the exposure of pebbles resulting from loss of the finer soil particles.

⁴ PECHANEC, JOSEPH F., AND STEWART, GEORGE. SAGEBRUSH BURNING—GOOD AND BAD. U. S. Dept. Agr. Farmers' Bul. 1948, 32 pp., illus. 1944.

Sandberg bluegrass, squirreltail, and bluestem wheatgrass may be present. In extreme cases the small openings between sagebrush plants may lack plant cover altogether, except annuals in unusually favorable years.

Severe soil losses by sheet and gully erosion usually have occurred, and soil fertility has been lowered. An erosion pavement and pedestaling beneath sagebrush plants and around perennial grass clumps may be even more noticeable than in the case of sagebrush with a scattered perennial grass understory. On level ground, however, or where the plant cover has been greatly changed by cultivation that was later given up, the soil may have been little eroded. The soil surface may be rather well-preserved even though the forage cover is depleted.

The natural plant cover has been damaged by cultivation and subsequent abandonment, or improper grazing often accompanied by haphazard burning. Spring-fall ranges with an understory mainly of annuals produce quantities of forage ranging from almost nothing to one-fourth as much as ranges with good understory of perennial grasses. Production is unstable in quantity from year to year; herbage dries 2 to 4 weeks earlier in the spring, and is of inferior quality compared with perennial herbage. In fact, the herbage is used but little for sheep grazing in the fall except when fall rains start new growth. Such ranges are normally classed as in poor to very poor condition.

Increases in perennials through good grazing management will be very slow, especially if soil depletion is well advanced. Generally, sagebrush removal immediately followed by reseeding is necessary to restore desirable perennial grasses within a reasonable time. Where restoration of perennials is not immediately practical, grazing management should be aimed at keeping as thick an understory as possible to prevent further soil loss.

On ranges having an understory composed mainly of annuals, the reward for following a program of improvement may be high including: (1) a grazing capacity four to many times greater; (2) a reduction of wool and lamb losses, and (3) a greater ease in handling sheep.

RANGE WITH SAGEBRUSH REPLACED BY CHEATGRASS OR ANNUAL WEEDS

Ranges on which the sagebrush and other original cover has been removed by recurrent fires or by plowing and abandonment of cultivation, together with improper grazing practices, now support nearly pure stands of annual grasses or weeds (fig. 4). Cheatgrass is by far the most widespread and important annual but others such as tumble-mustard, Russianthistle, stickseeds, and tansymustards occupy extensive areas. Such perennial grasses as Sandberg bluegrass giant wild-rye, squirreltail, and bluestem wheatgrass may be present in scattered stands on the deeper or more fertile soils.

Soil losses from sheet and gully erosion on annual grass and weed range usually are severe. Recurrent fires destroy litter and completely expose the soil. Overgrazing during the frequent years of low forage production also robs the soil of litter, reduces the content of organic matter, and frequently exposes it to the full play of wind and water erosion. Wind erosion may be especially severe where soils are some-

what sandy. Blow-outs and minature dunes are often formed. Unfortunately in many cases the extent of erosion is not easily detected. Removal of soil may have been more or less uniform over the entire soil surface, and unless long-lived perennial bunchgrasses are present, no pedestaled or hummocked vegetation appears as evidence of the



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FIGURE 4.—A range on which an almost pure stand of cheatgrass has become established following removal of the original vegetation. The herbage is suitable for grazing during only a few weeks in spring, and production is highly variable from year to year. Soil losses are high.

extent of soil removal. In many other instances, however, soil conditions of cheatgrass range may be fair to good, as on abandoned plowed lands that have not been burned over or overgrazed, and level ranges with fairly stable soil that have not been burned over often or too severely.

Cheatgrass ranges are useful for sheep grazing in the early spring and may be useful also in the fall if timely rains have brought on a good fall growth of cheatgrass. But the length of the spring period during which cheatgrass is usable by sheep is highly variable. In a cold or dry spring following a dry fall, with poor germination of cheatgrass, it may be a full month shorter than in other years. The quantity

of forage furnished is likewise highly variable. In years of poor growing conditions it may be as low as one-twelfth of that furnished in especially favorable years. The danger of fire is much greater and begins 4 to 6 weeks earlier in the summer than on adjacent ranges covered with perennial plants. As a result, fires burn over large acreages of cheatgrass range each year, destroying the herbage and litter, and forage production is lowered markedly the next year.

The return of desirable perennials under good grazing management is very slow and is likely to occur only under light grazing. For quick reestablishment of perennial grasses, reseeding is usually necessary. Plowing that reduces cheatgrass competition is usually required to enable the newly sown perennial grasses to become established. But on ranges covered with Russianthistle and other summer-growing annual weeds, reseeding can be done effectively by drilling without plowing.

Quality of soil may determine the objective in managing cheatgrass ranges. On most of the better soils of Idaho, the ultimate objective of management should be to replace cheatgrass with perennials. In many areas, reseeding may prove the most feasible method of attaining this objective. But where soils are very low in productivity, the restoration of perennials may be so difficult and so uncertain as to warrant continuous management of the range on the basis of the cheatgrass cover.

Lowered fire hazard, more uniform yearly forage production, and a longer season of use during the spring are among the rewards for replacing annual grasses and weeds with perennial forage plants.

RECOGNIZING RANGE TREND

Knowledge of range trend—whether the range is getting better or worse—is essential in planning a grazing program. Range trend signifies whether grazing practices of the past few years have been correct or there is need for remedial measures.

For each of the four categories of range described above, trend of condition is shown by distinct plant or soil indicators. Decision on upward or downward range trend usually should be made only after examination of all of these. With the exception of accelerated soil loss, a single sign indicating trend is seldom sufficient by itself to confirm that trend.

Signs of range improvement or deterioration usually appear first on the more palatable plants and on the soil in the openings between mature sagebrush plants. Attention should be concentrated on these during an inspection of range trend.

Signs of water erosion are most easily detected in the early spring, shortly after snow melts, and after heavy rains. Often they appear first on south- and southwest-facing slopes. Trampling of the soil by grazing animals during the grazing season will tend to destroy some signs of sheet and shoestring gully erosion.

Weather during recent years must be given allowance in judging range trend. One or 2 years of exceptionally favorable weather may give a range the appearance of improving even though a definitely downward trend of the range would easily be seen in a succeeding series

of normal years. During years of average or poorer-than-average weather, ranges show an upward tendency only if well-managed. On the other hand, ranges that show a downward tendency, especially by accelerated soil loss, following years of average or better-than-average forage production need immediate corrective measures in grazing management. Appearance of downward trend following years unfavorable to plant growth indicates a need for alertness in subsequent years to detect whether that trend is real or merely the result of unfavorable seasons.

Observation of the indicators over a series of years may be necessary for definite proof of the direction of trend. Annual records of indicators will reveal trends and are just as essential to the correct management of the range as records of stocking.

SAGEBRUSH WITH A GOOD UNDERSTORY OF PERENNIAL GRASSES AND WEEDS

Maintenance or improvement of sagebrush-grass ranges in satisfactory or nearly satisfactory condition is indicated primarily by maintained or increasing vigor of the finer grasses such as Nevada bluegrass and junegrass, and the palatable weeds, such as tapertip hawksbeard, tailcup lupine, arrowleaf balsamroot, and royal penstemon. Plants of these desirable species should be healthy, of a dark green color, and producing abundant herbage.

A few seedlings should be establishing themselves on any ranges that are not in fully productive condition. The larger grasses, bluebunch and bluestem wheatgrass, Indian ricegrass, and squirreltail should be vigorous. If the perennial grasses or weeds are growing on soil pedestals, the sides should be gently sloping and well covered with litter. Annuals should be few in number and low in height, frequently only 2 or 3 inches tall and poorly branched, except in years of exceptionally favorable rainfall. Established sagebrush seedlings should be few, even in years when numerous seedlings are found on nearby comparable but deteriorated ranges.

Gullies or rills are usually absent or healing.

Downward trend on ranges with a good perennial understory is indicated by lowered vigor of the finer grasses as shown by short stems, scarcity of flower stalks, small leaves, and by the fact that portions of clumps or entire plants are dead or dying, and that few if any seedlings are becoming established. Even some of the larger grasses may show some decline in vigor. Runoff from heavy rains may be muddy.

SAGEBRUSH WITH A SPARSE UNDERSTORY OF PERENNIAL GRASSES

Upward trend is indicated by increasing vigor and establishment of seedlings of the larger grasses, especially along the edges of soil pedestals. Colonies of bluestem wheatgrass should be spreading. If any mature plants of the finer grasses and weeds are present, a few seedlings should be establishing themselves. The sides of pedestals should be sloping and accumulating litter. Sagebrush seedlings may be present.

Gullies, where present, should have moderately sloping or rounded sides, and perennials should be establishing themselves on the bottom as well as the sides of the channel.

Downward trend of sagebrush range with a sparse perennial understory is indicated by a further loss of vigor, or death of perennial grasses and weeds, and a lack of seedlings. Pedestals may be sharp-sided and eroding, often exposing the grass roots. Young sagebrush plants will be growing rapidly (fig. 5).



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FIGURE 5.—Rapidly growing young sagebrush plants in the openings between mature sagebrush plants indicate downward trend on spring-fall range.

Gully erosion may be increasing on sloping lands. The gullies will be V-shaped with steep, raw sides, almost devoid of perennial plants. Fresh cutting of the bottom of gully channels indicates continued growth of the gully system and a downward trend.

SAGEBRUSH WITH AN UNDERSTORY CHIEFLY OF ANNUAL GRASSES AND WEEDS

Improvement is shown by the establishment of a few desirable forage grasses along the edges of pedestals, or near sagebrush plants. Annual grasses and weeds may be vigorous in the openings as well as under sagebrush. Sides of pedestals are becoming more sloped and covered with litter.

Gullies should have a good cover at least of annuals and perhaps a few Sandberg bluegrass plants both on the bottom and along the gently sloping, well-rounded sides.

Further deterioration is shown by low vigor of annuals. In the openings between sagebrush these may be short, stunted, or entirely

absent. Very few seedlings of perennial grasses and palatable weeds will be establishing themselves. Pedestals will be sharp-sided. Gullies may be active and growing as evidenced by steep, raw sides and recurrent cutting in the bottom and sloughing of the sides (fig. 6).



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FIGURE 6.—Sharp-sided gullies and active erosion on a sagebrush range are signs of a continuing downward trend.

RANGE WITH SAGEBRUSH REPLACED BY CHEATGRASS OR ANNUAL WEED. (Managed for Return of Perennials)

Improvement of such ranges is usually slow and may be first indicated by development of a heavy litter mat that has accumulated over the years. Where old perennial grasses remain they are vigorous. Seedlings should be establishing themselves. Pedestals are rounded, and gully walls are becoming well rounded, protected by a mat of litter and a good stand of annuals.

Downward trend is indicated by increasing abundance of annual weeds while cheatgrass is low in vigor and failing to reproduce well even in years with ample fall and early spring rainfall. Gullying and wind erosion are active. Very little litter is accumulating.

MANTAINING OR IMPROVING RANGE CONDITION

Good grazing management is the chief means by which range productivity can be restored and maintained. On some ranges such supplemental practices as range reseeding, sagebrush eradication, fire control, or water development may also be necessary. A well-considered program of grazing management and reseeding will be of advantage to the range and the sheep, and consequently to the operator.

On spring-fall sheep range, this program should have the following objectives:

1. To protect the soil against accelerated erosion. Soil is the basic resource of the range, upon which forage productivity depends. When fertile topsoil is lost, range productivity in forage, meat, and wool suffers. It is much more difficult to restore range productivity where the fertile topsoil is gone than where only weakening or death of the forage plants has taken place.
2. To maintain or increase the desirable and palatable perennials in the openings between sagebrush plants. These perennials furnish the available forage for sheep and protect the soil against erosion.
3. To keep a good mixture of perennial plants. Sheep prefer the succulent grasses and weeds in spring, and shrubs as well as grasses in fall. A good mixture improves the palatability and nutritive value of the forage in either season.
4. To keep the stand of sagebrush open enough to permit easy herding and reduce losses from straying, predators, or snagging of wool.

The program for grazing should outline the range practices to be followed in the spring and in the fall—when to graze, how many sheep to graze, how closely to utilize the plants, what grazing systems to follow, and any other practices that are justified to improve range forage and sheep production. Spring is the season during which the range sheepman will find it most profitable to take great care in handling his spring-fall range.

WHEN THE RANGE SHOULD BE GRAZED IN SPRING

When spring grazing may be safely begun is one of the most important questions to be answered in good grazing management. Naturally, to reduce expenses, the sheepman wants to get his sheep out of the feed lot as soon as possible after snow melts. On the other hand, studies have shown that grazing early in the spring while the soil is still wet and before plant growth is adequate to provide ample forage is one of the most common causes of injury to the range and lowered animal production.

Spring grazing should begin only when the soil has dried enough to be firm after snow melt. Trampling so compacts fine-grained soil when it is wet that it dries hard and will not readily absorb rainfall. Consequently, the desirable forage plants have less moisture available because part of the rainfall runs off. This also washes away fertile topsoil. Furthermore, when the soil is wet trampling by sheep cuts up the roots of perennial grasses and weeds, uproots young seedlings, and seriously damages insecurely rooted young plants.

Spring grazing can be started safely when there is sufficient growth to satisfy requirements of the sheep and still retain enough herbage to produce the plant food that is essential for vigorous continuing growth. In this way, damage from too heavy early utilization will be avoided. In the spring sheep graze but little on the dry grass left from

previous years. Judging whether there is sufficient forage to start grazing must, therefore, be on the basis of new, green growth. When plant growth is insufficient, sheep tend to travel widely in search of forage. Moreover, where good forage is scarce, sheep often eat such poisonous plants as deathcamas or spineless horesbrush which they normally would not graze. Resulting losses may more than offset the feed-lot costs saved by turning sheep out a few days early.

After leaves of bluebunch wheatgrass average $2\frac{1}{2}$ inches in height, there is sufficient plant growth to begin grazing and the soil is generally firm.⁵ Even though less than 10 percent of the total yearly pro-

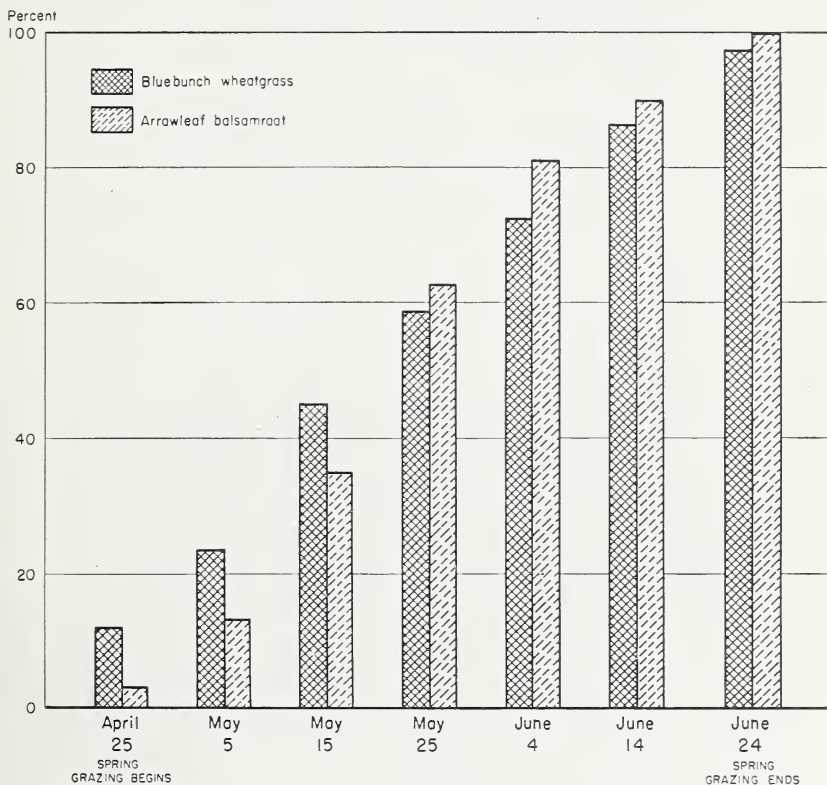


FIGURE 7.—Average cumulative herbage production, in percent of total yearly production, of bluebunch wheatgrass and arrowleaf balsamroot on spring-fall range. United States Sheep Experiment Station, 1941 to 1944. Only a small part of the total yearly production is available when the sheep begin grazing in the spring.

⁵ Vegetative readiness on the gently sloping and comparatively dry spring-fall ranges here considered is reached at a much lower plant height than is advocated for high summer ranges. On summer ranges many slopes are so steep that erosion may become active, persistent snow banks keep the soil muddy into late spring, and north- and east-facing slopes materially retard the average earliness of plant development. To offset these characteristics unfavorable to early grazing, a much later stage of plant development has been taken as indicating readiness on summer ranges.

duction is available at this time, grazing may be safely begun if the plants are not grazed too closely and repeatedly in the same spring (fig. 7). When repeated grazing is unavoidable the average height of bluebunch wheatgrass should be greater than $2\frac{1}{2}$ inches before grazing is started.

The stages of growth of associated plants when bluebunch wheatgrass leaves average $2\frac{1}{2}$ inches in height are as follows:

Annual grass:

Cheatgrass leaves at least $1\frac{1}{2}$ inches high.

Perennial grasses and grasslike plants:

Sandberg bluegrass leaves about 2 inches high, on south slopes a few flowerstalks present, low in the boot.

Needle-and-thread, Indian ricegrass, bluestem wheatgrass leaves 3 to 4 inches high.

Threadleaf sedge flower heads fully out.

Perennial weeds:

Such early blooming perennials as the mosslike phloxes, violets, lomatiums, and buttercups beginning to bloom heavily.

Deathcamas leaves 6 to 8 inches high.

Wild onion leaves 4 to 6 inches high.

Woodland stars just beginning to bloom.

Arrowleaf balsamroot and tailcup lupine just beginning growth, leaves 1 inch high.

Shrubs:

Rabbitbrush and spineless horsebrush beginning to leaf out heavily.

Spring grazing on cheatgrass ranges or where cheatgrass furnishes the bulk of forage should be started only after cheatgrass is at least $1\frac{1}{2}$ inches tall, and the soil is firm.

On the upper Snake River Plains during the period from 1923 to 1945, inclusive, April 26 was the average date on which the soil was firm enough and there was sufficient plant growth to begin grazing. From a few years of observation on the lower Plains in the vicinity of Payette and Caldwell the average date of readiness is estimated to be about March 15. Near Burley and Twin Falls it is April 3, and near Pocatello April 5.

An arbitrary rule of thumb useful for estimating range readiness when dates at other locations are known is to allow one more day for each 100 feet additional altitude. In a general way this proves out on the Snake River Plains, but in its application such other factors as differences in direction of slope, texture of soil, and depth of winter snow cover must be considered. Forage plants on south-facing slopes begin growth earlier than those on north-facing ones, sandy soils warm up earlier than do clay soils, and forage species in the localities covered with heavy winter snows generally reach range readiness later than those with light winter snow.

At the U. S. Sheep Experiment Station a 23-year record of plant growth showed a difference of 37 days between the earliest and latest dates at which range readiness was reached. No year was later than average by more than 11 days. In 7 of the 23 years the date of range readiness was from 5 to 11 days later than the average. In planning his yearly operation the range sheepman therefore will find it advisable to have on hand a supply of hay for 7 to 10 days more than is needed in the average year. This hay is insurance against the occasional cold, backward spring.

When perennial grasses and weeds provide most of the forage, sheep, especially ewes and lambs, should be moved from the spring range as soon as forage plants begin to dry. This occurs about May 15 on the lower Snake River Plains and June 20 on the upper Plains. By the time herbage is beginning to cure, the nutritive value of the grasses and weeds has become rather low.⁶ For example, on the upper Plains, tests showed bluebunch wheatgrass and arrowleaf balsamroot herbage to be comparatively low in crude protein and phosphorus by June 10 (fig. 8). Such deficiencies in the forage cause milk production by ewes to decrease. Lambs, as a result of the decrease in milk and the lowered quality of forage they consume, begin to slow down in rate of growth and lose their "bloom." If held on drying forage for very long, lambs are likely to suffer a prolonged set-back in growth.

Where cheatgrass provides most of the forage, the spring grazing season should end when the cheatgrass begins to dry and turn red. This occurs 3 to 4 weeks before perennial grasses begin to dry. As cheatgrass turns red its nutritive value decreases and sheep grazing on it do not thrive. There is also danger of injury to the sheep's mouths from the sharply bearded cheatgrass seeds which are then rapidly maturing. Moreover, the range may be injured at this time because sheep select the more succulent perennials and graze them very closely.

HOW MANY SHEEP SHOULD BE GRAZED

The key to maintaining ample forage year after year on spring-fall sheep range is conservative grazing, that is, stocking with only the number of sheep that the range can support over a period of years without injury to the desirable plant species or to the soil. To permit improvement of ranges that are in an unsatisfactory condition, the forage plants should be less heavily grazed than those on ranges in satisfactory condition.

Range pastures stocked with the proper number of sheep at the U. S. Sheep Experiment Station were maintained or improved in condition. Four pastures, stocked roughly 25 percent heavier for 4 years, declined in condition. Some of the more palatable grasses and weeds were killed out and sagebrush invaded the openings.

Determining the number of sheep that a range will properly support involves several inspections and adjustments. At first the range should be stocked in accordance with the best available preliminary estimate of its grazing capacity. This estimate may be made by one of the three following methods.

1. *Through past stocking records.*—One index to the number of sheep that can be grazed is a record of actual sheep use for several years, together with a close examination of the present range condition and the trend in condition. Where past stocking has been nearly correct this is a reliable method. If a satisfactory range condition is being maintained, or deteriorated range is on the upgrade, but there is no undue waste of forage, the stocking rate of the past few years

⁶According to standards determined by the National Research Council, forage for sheep with lambs becomes inadequate when the phosphorus content is below 0.22 percent and definitely deficient at 0.11 percent or below.

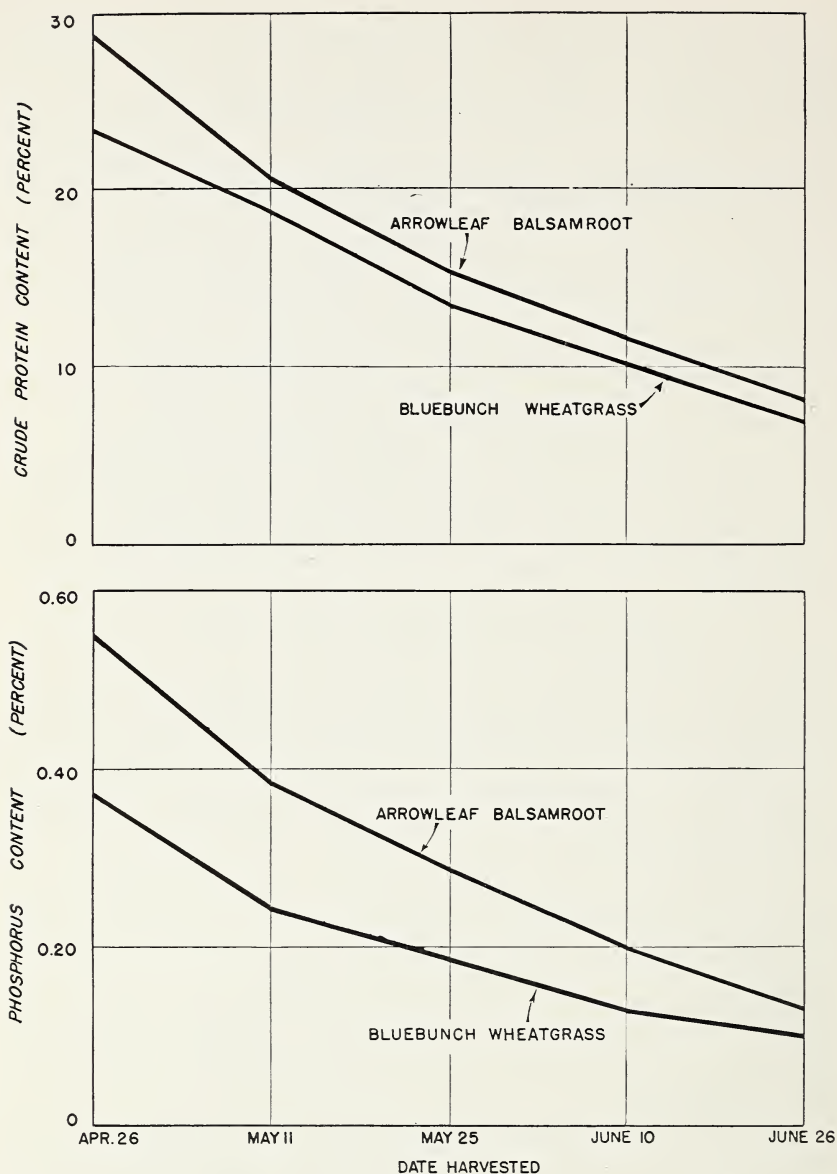


FIGURE 8.—Crude protein and phosphorus content of bluebunch wheatgrass and arrowleaf balsamroot herbage. The protein and phosphorus contents are high during the first part of the spring but decrease rapidly to rather low levels by the end of the spring season. Data are average percentages on a dry weight basis for 4-year period, 1937–40, at the U. S. Sheep Experiment Station.

is satisfactory. Where the range is on the downgrade, fewer sheep should be placed on the area or the grazing season should be shortened. Where distinctly more herbage is being left ungrazed than is needed for protection of plant vigor and soil, an increase in the number of sheep may be permitted.

2. *Through stocking records on similar adjacent or nearby ranges that are conservatively grazed.*—A guide for an estimate is often provided by a nearby range that has been maintained or improved in condition over a period of years. To make the estimate, it is necessary to compare the stocking records and the condition and trend of the two ranges.

3. *Through range surveys.*—An estimate of grazing capacity can be made through an inventory of the amount of forage produced and of the various physical features of the range that may affect its use. Properly conducted range surveys including systematic collection of data in the field and careful compilation and interpretation provide a very good basis for estimating grazing capacity.

Whether the preliminary estimate has resulted in placing the correct number of sheep on the range, can be checked by examining how closely the forage plants have been grazed at different dates during the grazing season. Adjustments should then be made in sheep numbers to correct for too heavy or too light use. For example, if the forage plants are grazed as fully as they can withstand when only three-fourths of the season is past, then a 25-percent reduction in sheep numbers for the whole season is indicated. Grazing, checking the use received, and making adjustments may need to be repeated for several years, until the proper number of sheep are grazing the range.

In deciding on how closely plants should be grazed, allowances must be made for maintenance of plant vigor, fall grazing, wide fluctuations in forage production from year to year, the effects of severe drought, and need for soil protection.

These factors have been considered in making recommendations of the percentage of current herbage production that should be left ungrazed for each of the chief plant species in each category of range in an average year. The recommendations, for level to rolling range, are shown in the tabulation following. Herbage left ungrazed is measured only by the herbage available to livestock—not that protected by shrubs. In years of about average growing conditions, percentages left that are within 5 percent of those given are fully satisfactory.

On ranges with a perennial grass understory, and on annual ranges being managed for the return of perennials, at least two-thirds by weight of the herbage produced by bluebunch wheatgrass or other coarser perennial bunchgrasses should be left ungrazed in the average spring. At this intensity of grazing on ranges with a good perennial understory, only 40 to 60 percent of such associated and more desirable grasses and weeds as Nevada bluegrass, needle-and-thread, arrowleaf balsamroot, tailcup lupine, and tapertip hawksbeard will remain ungrazed. When less than this amount of the desirable perennials remains ungrazed, the plants lose vigor. Some die and others are hampered in competing with other plants. Cheatgrass or sagebrush increase, and the quantity and quality of the forage deteriorates.

Following is a schedule of the percent of total growth of certain herbage that should be left at the end of the season:

<i>Range category and plant species</i>	<i>Percent of total growth of herbage to be left at end of season, in average year</i>	
	<i>Spring</i>	<i>Fall</i>
Sagebrush with good understory of perennial grasses and weeds:		
Bluebunch or bluestem wheatgrass-----	70	55
Nevada bluegrass-----	60	30
Needle-and-thread-----	50	30
Arrowleaf balsamroot-----	50	40
Royal penstemon-----	40	40
Bitterbrush-----	95	85
Big or threetip sagebrush-----	100	95
Sagebrush with sparse understory of perennial grasses:		
Bluebunch or bluestem wheatgrass-----	80	60
Sandberg bluegrass-----	50	40
Squirreltail-----	70	50
Big or threetip sagebrush-----	100	95
Sagebrush with an understory chiefly of annual grasses and weeds:		
Sandberg bluegrass-----	60	50
Cheatgrass-----	80	80
Big or threetip sagebrush-----	100	100
Cheatgrass range:		
Being managed for return of perennials:		
Bluestem wheatgrass-----	70	50
Sandberg bluegrass-----	60	50
Squirreltail-----	70	50
Cheatgrass-----	80	80
Being managed only for soil protection:		
Cheatgrass-----	50	50

Spring grazing on cheatgrass ranges being managed for return of perennials should be based on utilization of perennials in the stand even though they are very scarce. Under such conditions seldom more than one-fifth of the cheatgrass herbage will be utilized. On cheatgrass ranges managed only for protection of the soil, however, approximately half of the cheatgrass herbage may be safely grazed in the spring. Cheatgrass provides the only soil protection and the bulk of the litter that is returned to the soil. When less than one-half of the annual production is left ungrazed, the soil is inadequately protected against wind and water erosion. Too little of the annual herbage production becomes beneficial litter. As a result of soil loss and decline in fertility, the range will eventually support fewer and smaller cheatgrass plants and, therefore, produce less forage.

Where ranges are to be used in the fall it is unwise to rely on additional growth during the late summer or fall. At the U. S. Sheep Experiment Station, late summer and early fall growth of grasses produced appreciable forage in only 3 of the 15 years, 1930-44. The 75-year weather record at Boise indicates a likelihood of good fall growth in that locality only once in 6 years, and of some fall growth in half of the years. At Pocatello the 44-year weather record indicates a likelihood of good fall growth in only 1 out of every 3 years and some growth in half the years.

Enough herbage should be left at the end of the spring grazing

period to provide adequate fall forage. The amount to leave will depend on the number of sheep to be carried on range in the fall and should vary with the kind of range and the palatability of forage plants. On sagebrush range with a good understory of perennials, leaving 70 percent of the herbage of the wheatgrasses ungrazed in the spring permits good growth if weather conditions are favorable. It also leaves for fall grazing some of the herbage produced in the spring. About 50 to 60 percent of the herbage of the wheatgrasses should be left after the additional grazing in the fall. Where there is a sparse perennial understory, herbage needs to be left. About half of the herbage of finer grasses remaining after spring grazing should be left after fall grazing. Many weeds that are palatable in the spring and may have had only 50 to 60 percent of their herbage grazed in that season, will not be further used in the fall. Since cheatgrass ranges usually furnish little fall forage, there is only a slight difference in the amount of herbage utilized at the ends of the spring and fall grazing seasons.

It is not necessary to have as much of the current herbage production of perennials left ungrazed at the end of the fall grazing season as at the end of spring. By fall the plants are mature and less susceptible to injury than in spring. They can stand heavier use. Even so, fall grazing must be conservative. The herbage left after spring grazing provides for the production of plant foods needed to maintain vigor, produce seed, and support early growth the following spring. The herbage left in the fall protects the root crown of herbaceous species against cold during the winter. Later, in the early spring, it protects new growth against injury from hard frosts and drying winds. In experiments at the U. S. Sheep Experiment Station a conservative grazing policy followed during the fall for a period of 9 years permitted a 15-percent increase in grazing capacity, an increase in perennial grasses and weeds, and a decrease in sagebrush.⁷

Adequate allowance should be made for wide yearly fluctuations in forage production. Where perennial grasses and weeds furnish most of the forage the amount produced may easily vary from one-third below to one-third above average in a few years. During the 17-year period 1924-40, forage production at the U. S. Sheep Experiment Station was in 1 year 66 percent below and in another year 61 percent above average (fig. 9).

Much wider fluctuations in herbage production occur on cheatgrass ranges, or sagebrush ranges with an understory of cheatgrass, than on those which furnish perennial grass forage. Observations on ranges of the Snake River Plains indicate that production of cheatgrass in 1943 was not more than one-sixth to one-eighth of that in 1941 or 1942. Data from a range survey in Gem County, Idaho,⁸ show that herbage production in 1937 was from one-twelfth to one-fifth of that in 1938. Such wide variations in production are characteristic of cheatgrass.

The range sheepman is not prepared to vary his sheep numbers rapidly and widely enough to meet the extreme fluctuations in herbage

⁷ CRADDOCK, G. W., AND FORSLING, C. L. THE INFLUENCE OF CLIMATE AND GRAZING ON SPRING-FALL SHEEP RANGE IN SOUTHERN IDAHO. U. S. Dept. Agr. Tech. Bul. 600. 41 pp., illus. 1938.

⁸ STEWART, GEORGE, and YOUNG, A. E. THE HAZARD OF BASING PERMANENT GRAZING CAPACITY ON *BROMUS TECTORUM*. Amer. Soc. Agron. Jour. 31: 1002-1015. 1939.

and forage production on spring-fall ranges. His best recourse is to maintain a nearly constant rate of stocking that is low enough to provide adequate forage in all but extreme drought years. A stocking level that results in using only about two-thirds of the forage in the average year has been found safe for spring-fall ranges (fig. 9). With this level of stocking about 50 to 60 percent of the herbage of finer grasses will be left after spring grazing, and 30 to 40 percent will be ungrazed at the end of the fall season. Only about 40 to 50 percent of the herbage of the wheatgrasses will be utilized at the end of the fall. This will result in leaving considerable herbage in the average years.

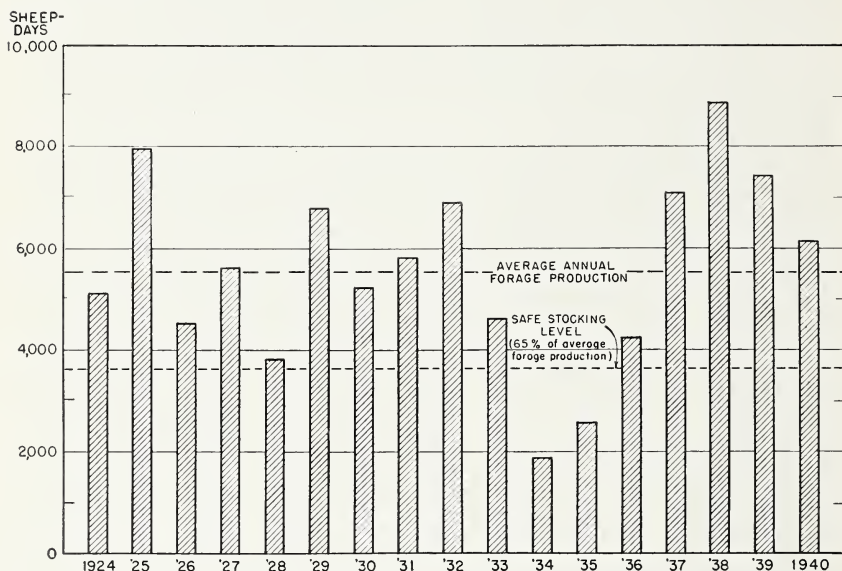


FIGURE 9.—Forage production of two 80-acre pastures in satisfactory condition, 1924-40, U. S. Sheep Experiment Station. Production is expressed in sheep-days of grazing that could have been obtained without injury to the range. Production in the poorest year is but 21 percent of that in the highest year.

Records at the U. S. Sheep Experiment Station, on spring-fall range in satisfactory condition grazed equally during the spring and fall, show that such a level of stocking will operate successfully. During the 17-year period 1924-40, ample forage was assured by this level of stocking in all but 2 years, 1934 and 1935. Considerable forage was left ungrazed in such wet years as 1925, 1929, 1932, 1937, 1938, and 1939, but this was not wasted. During these years many plants had an opportunity to reach maturity before being grazed and thereby to recover from ill effects suffered during dry or otherwise unfavorable years. Thus, maintenance of plant vigor was assured in good and poor years alike by this conservative level of stocking.

Not only does a severe drought, such as occurred in 1934, cause a marked drop in the number of sheep that may be safely grazed during the year of drought, but it causes prolonged injury to the range. Sheep had to be removed 3 weeks earlier than usual from the 80-acre

experimental pastures at the U. S. Sheep Experiment Station in the spring of 1934, but even under this practice 85 percent of the herbage production of coarser bunchgrasses had been utilized—nearly three times the recommended utilization. The combined effect of drought and overgrazing killed and weakened so many plants that forage was deficient in 1935 also, even though more favorable growing conditions prevailed. Records from these range pastures and from detailed plot studies showed that not until 1937 had perennial bunchgrasses fully recovered from the effects of the 1934 drought.

Unfortunately, it is seldom possible to be sure that a serious drought year is at hand until the spring grazing season is well advanced. Light winter snows may give an indication of a poor growing season to follow. But it is not advisable to graze fewer sheep on this basis alone, since timely spring rains may correct the deficiency in winter moisture and promote an abundance of forage. Nor is it ordinarily possible to remove sheep at a date earlier than usual, since irrigated pastures or supplementary range are seldom available to carry the sheep until summer range is ready to be grazed.

What is necessary, when general drought has occurred on the spring range, is immediately to make plans to permit range recovery. Since the drought injury to vegetation that has occurred will not be overcome for 1 to 3 years, the rate of stocking should be reduced in the years immediately following drought. This may be done either through a shortening of the spring grazing season or a decrease in numbers grazed. When the drought has occurred only on the spring range, adjustments in rate of stocking may be made through the development of supplementary spring pastures or through culling breeding stock. When a general drought on all seasonal ranges has occurred, as in 1934, a sharp reduction in sheep numbers is necessary. These reductions may be brought about most effectively by careful and more rigid culling than is ordinarily practiced. Sheep that are small, unsound, overaged, of poor mutton conformation, or with fleece that is light or of short staple, can be sorted out and sold. A few years later, after range recovery from the drought is well under way, arrangements may properly be made to increase numbers, but at a rate not exceeding the rate of range recovery.

On cheatgrass ranges the extremely wide fluctuations in forage production that usually occur make it extremely difficult to set any constant level for the number of sheep the range will carry. Not only is forage production low during drought years, but it is exceedingly low the next year also if dry fall weather delays cheatgrass germination until spring and the following spring is cold or dry, as in 1937 and 1943. The range sheepman at such times is faced with the necessity of moving sheep off cheatgrass range much earlier than he had planned.

Fewer sheep can be safely grazed where slopes are moderate to steep than on comparable level or moderately rolling ranges in similar condition. Soils erode easily from steep slopes and the greater the slope the more readily does serious water erosion take place. Thus on slopes slightly steeper than 30 percent (a rise of 30 feet in 100 feet horizontal distance), it is estimated that not more than three-fourths as many sheep should be grazed as on similar level range. If slopes

are markedly steeper than 30 percent, still lighter use is probably advisable. Slopes with loose granitic or sandy soils can support fewer sheep than can slopes with more stable soils.

GRAZING SYSTEMS TO USE

Any efficient system of grazing spring-fall ranges must take into consideration that the range is being grazed in the spring when plants are most easily injured. Most of the range plants reproduce by seed, and periodically require an opportunity to mature and scatter seed.

The rotation grazing system is well adapted to these needs. It is one of the most effective methods of maintaining range in satisfactory condition or improving range in unsatisfactory condition. Under this system a range area is divided into two, three, or four units. Each spring the units are grazed in sequence planned so that no unit is grazed during the same part of the spring in consecutive years.

For example, where a spring range is divided into four units of approximately equal grazing capacity, sheep might begin spring grazing on unit A, move to unit B for the second quarter of the spring season, thence to unit C for the third quarter, and to unit D for the last quarter. The following year sheep would graze unit B during the first quarter, then C, D, and A, respectively, for the second, third, and fourth quarters. During the third year the sequence of grazing would be C, D, A, and B, and during the fourth year D, A, B, and C. In the fifth year the sequence of grazing is the same as for the first year, each unit being grazed during the same part of the spring that it was 4 years earlier.

Some leeway and good judgment are needed to carry on rotation grazing successfully over a period of years. The plan must not be made too rigid. In a cold, backward spring, it may be necessary in the first period to use both of the first two units in the rotation to secure ample forage for the sheep and avoid injury to the desirable plants. Different adjustments may be found necessary in other years, but they should always accord with the essential principal of rotation—no one section of the range should be grazed during the same part of the spring in successive years.

On spring-fall ranges, under rotation grazing, each unit is grazed only once during a spring period. This permits plants that were grazed early to make regrowth and build up an adequate supply of food reserves in the roots before the end of the spring season.

Advantages to vegetation derived from rotation grazing are at least fourfold:

1. Early spring grazing of the same area year after year and repeated grazing in the same year are avoided. Even the number of sheep conservatively based on total yearly production will heavily utilize the small amount of forage produced during the first part of the spring season. Records at the U. S. Sheep Experiment Station show that when spring grazing began, bluebunch wheatgrass and arrowleaf balsamroot had produced only 12 and 4 percent, respectively, of their total yearly growth (fig. 7). Ten days later they had made less than 25 and 15 percent of their total yearly growth.

2. Grazing the same area year after year during the critical reproductive periods of plants is avoided. During the period closely

associated with the time of blooming—especially if the soil is still moist—plants can easily be injured by close grazing. With bluebunch wheatgrass and arrowleaf balsamroot this critical period begins when bluebunch wheatgrass flowerheads are appearing but are not yet fully out, and arrowleaf balsamroot is in full bloom. It ends when bluebunch wheatgrass heads are fully out and starting to bloom and when arrowleaf balsamroot seed is ripening. At the U. S. Sheep Experiment Station, this period usually occurs between May 25 and

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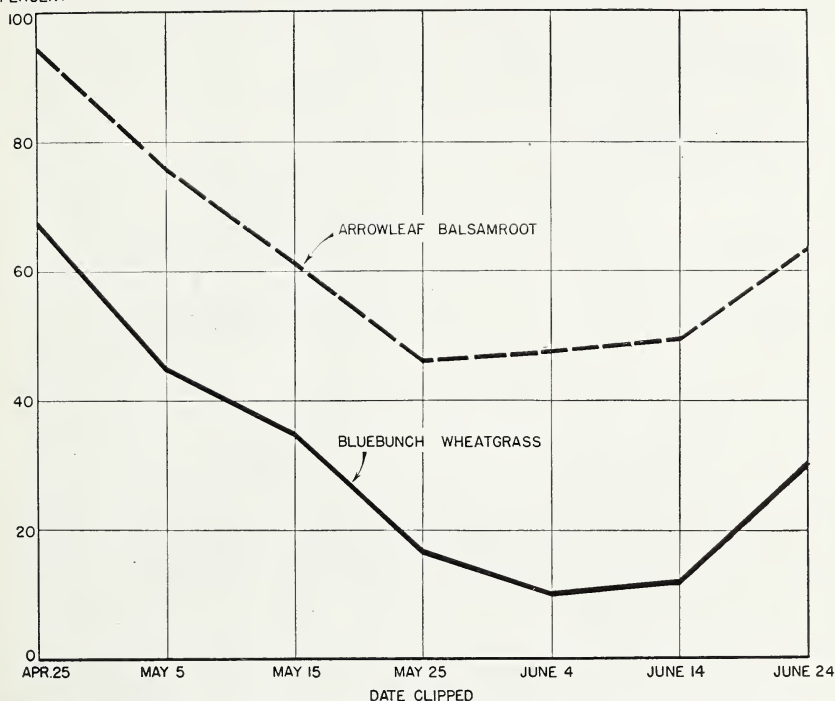


FIGURE 10.—Average yields of herbage, 1942-44, on plants clipped to ground level at different dates the preceding year. Yields are expressed in percent of the yield of comparable plants unclipped the previous year. During the period between the middle and last 10 days of the spring grazing season, clipping reduces yields much more than at other times. Data from U. S. Sheep Experiment Station.

June 15 (fig. 10). Other species also have critical periods, which may differ in date of occurrence from those of bluebunch wheatgrass and balsamroot. Therefore, even a moderate rate of stocking of spring-fall ranges during the same part of the spring season year after year may inflict injury on species whose critical period coincides with the period of grazing. When severe grazing year after year during the critical period removes all herbage nearly to the ground line, many of the plants are killed, and forage production is drastically reduced. Grazing is seldom so severe except on or near bedgrounds that are used for long periods, or near reservoirs, wells, or other permanent watering places.

3. Seasonally palatable species are not consistently grazed year after year during the time they are most palatable. Nearly all of the desirable and palatable plant species on spring-fall ranges are more palatable during certain parts of the spring than at other times. For example, sheep take such species as Sandberg bluegrass, Nevada bluegrass, and Indian ricegrass with greater relish during the early part of the spring, and such species as tapertip hawksbeard, tailcup lupine, and bitterbrush during the latter part of the spring season (fig. 11).

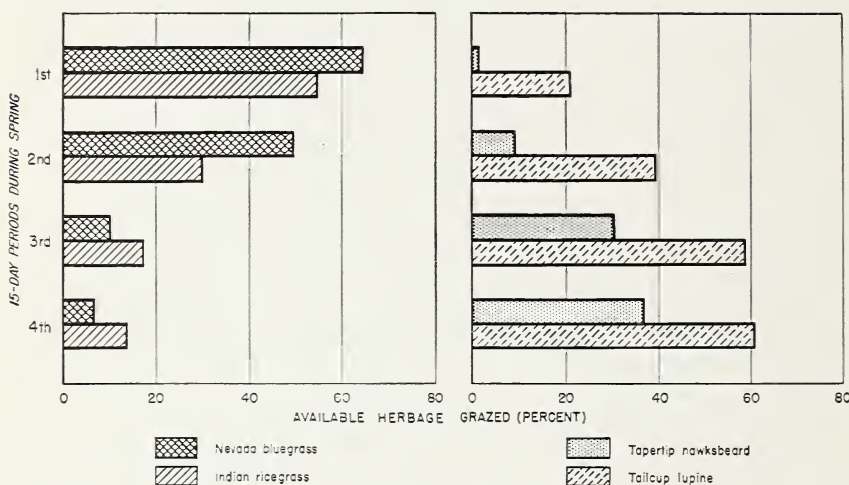


FIGURE 11.—Percent of available herbage of four range species grazed by sheep in each of four range pastures stocked during successive 15-day periods in the spring, U. S. Sheep Experiment Station. Some forage plants, like Nevada bluegrass and Indian ricegrass, are most palatable early in the season. Others, like tapertip hawksbeard and tailcup lupine, are most palatable toward the end of the spring.

When grazed at the time of its highest palatability a plant species will be more heavily used in comparison with associated species than it would otherwise be. Any attempt to get full grazing use of associated species may damage those highly palatable at this particular period. When a range is grazed at the same time year after year serious injury or even killing of some particular species is likely to result.

4. Seed production by many of the more valuable species is encouraged. Such species as bluebunch wheatgrass and tapertip hawksbeard, even though grazed fairly heavily during the early spring only, will produce some flower stalks and seed by the end of the spring season. Other species such as arrowleaf balsamroot, Sandberg bluegrass, and tailcup lupine will have matured some seed by the time grazing is begun on units grazed late in the spring. Flower stalks of Indian ricegrass and needle-and-thread are unpalatable late in the spring and will remain untouched on units grazed then. Seed from these sources, together with that of ungrazed plants, will assure an ample supply during years when weather is favorable for seed production.

In actual operation on the range, rotation grazing requires but little more effort than the customary method of routing grazing over

the range in the same way each year. In dividing a range into units, the size, shape, and general topography of the range area will influence the size and shape of the unit. Units should be large enough to permit open herding of the sheep. Roads, streams, fences, rock monuments, or some other features readily distinguishable by the herder can be used as unit boundaries.

Under some circumstances rotation grazing may not be easy to arrange. In southern Idaho, there is often a definite grazing migration of sheep from lower to higher spring ranges. Early-, mid-, and late-spring forage supplies are obtained on ranges many miles apart along a route of travel that leads from the winter feed lot to the summer ranges. It is, therefore, nearly impossible to graze the early spring unit later or the late spring unit earlier. On other ranges the location of seasonally available supplies of water dictates when various areas are grazed; or there are marked differences in elevation within a small distance and consequently a great spread in the time at which various parts are ready for grazing. On cheatgrass ranges, or on sagebrush ranges having an almost pure understory of cheatgrass or Sandberg bluegrass, rotation grazing may mean a loss in forage on units reserved for late grazing. Cheatgrass and Sandberg bluegrass herbage dries early and will have become unpalatable on the unit grazed last in rotation.

In all of these circumstances it may be possible to work out a short two-unit rotation. On ranges where there is a definite migration the sheep might be started 1 year at the right side of the route and swung to the left on the mid- and late-spring ranges. The following year grazing could start at the left and swing to the right. Similar short two-period rotations may be feasible where water, range readiness, or palatability dictate the period of range use.

The deferred spring grazing system is well adapted to spring-fall ranges. Under this system the range is divided into two, three, or four units of approximately equal grazing capacity. Each year, one unit will not be grazed in spring, at least until major forage species have matured. Fall grazing, if of reasonable intensity, injures the plants little and should be practiced on all units. Allowing the desirable forage plants to grow to maturity permits them to build up plant reserves and recuperate in vigor. Forage plants will produce flower stalks and seeds on ranges deferred in a year when favorable weather conditions prevail. Sheep grazing in the fall will scatter and tend to cover the seed by trampling, thus aiding in the successful establishment of seedlings.

Deferred grazing especially favors perennial weeds (fig. 12). They are the species most heavily grazed during the spring and thus most likely to be injured; but they are undamaged by conservative fall grazing. Thus, during the years of deferment, these species receive almost complete rest from grazing.

The range unit in most critical condition is ordinarily the first to be deferred. In subsequent years other units are deferred in the order of their need for improvement. Grazing on the selected unit is deferred from spring use for 1, 2, or 3 successive years, or as long as is needed to show improvement. On many ranges with a scattered understory of perennials, 2 to 4 successive years of spring deferment

may be necessary to allow seedlings of desirable species an opportunity to become firmly established in the bare and eroded openings between sagebrush plants.

On cheatgrass range, it is unlikely that deferment for 2 or 3 successive years will prove desirable. An accumulated mat of dead, ungrazed herbage tends to stagnate cheatgrass and decrease production not only of cheatgrass but of perennial grasses as well.



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FIGURE 12.—Deferring grazing until fall favors an abundance of palatable perennial weeds. At left, range having an abundance of arrowleaf balsamroot has been grazed only in the fall for 9 years; at right, range overgrazed each spring for same 9 years.

Protection from spring grazing is not needed to permit cheatgrass to produce ample seed. Since the dried forage of cheatgrass is of little value for fall grazing by sheep, deferment means almost complete loss of the forage crop in an ordinary year. Furthermore, the ungrazed dry herbage on cheatgrass ranges may increase the fire hazard during both the year of deferment and the following year.

For the successful application of deferred spring grazing the range as a whole must not be fully stocked or overstocked. The forage on the deferred unit is not available for spring use. To compensate for this, the number of sheep grazing the whole area during the spring must be reduced until recovery brings increased forage. Otherwise the load on the remainder of the range during the period of deferment would be increased and would likely result in too heavy grazing.

Deferred grazing may also have an important part in improving spring-fall ranges where a definite migration of sheep from lower to higher ranges is followed or where early-, mid-, and late-spring forage is obtained on ranges distant from each other. A part of each seasonal unit may be deferred each year to permit increase in plant vigor and seed production.

OTHER PRACTICES THAT AID RANGE IMPROVEMENT

Good distribution of sheep grazing and good herding practices, use of bedgrounds for not more than three successive nights and preferably one night, proper salting, and provision of ample watering facilities are other practices that promote better grazing use of the spring-fall range. They therefore contribute toward maintenance or improvement of the forage cover and the most efficient sheep production.

Distribute grazing uniformly over the range.—Uniform grazing use of all portions of the range is of advantage both to the sheep owner and the range. Fortunately, distribution of sheep is so largely under the herder's control that good practice is primarily a matter of deciding what will be done in regard to routes of travel, herding practices, and use of bedgrounds. Then the herder by directing the movements of the sheep largely determines how uniformly the range is utilized.

Use good herding practices.—Sheep should be permitted to graze openly and quietly with as little disturbance and driving as possible (fig. 1). They should be allowed to begin grazing soon after daybreak. Their course of travel, as they move from the bedground, can be so directed by the herder that the herd will spread widely over the area being grazed that day. Forward movement of leaders of the flock is checked if necessary.

In herding it is advisable to use dogs as little as possible. In this way it is possible to avoid holding the sheep in a compact bunch. Older and infirm ewes at the rear of the flock have an opportunity to keep up and their forage is not confined to what is left by other sheep. Excessive travel, wastage of forage through trampling, and severe trampling of the soil are avoided by permitting the herd to graze openly.

Use bedgrounds only from one to three nights.—By changing bedgrounds often, trampling is reduced and sheep are on or near fresh forage from the time they leave the bedground in the morning until they bed down at night. They have a chance to choose those more palatable and succulent grasses and weeds that promote the maximum flow of milk. They are not forced to eat less valuable plants that have been left after the area adjacent to a bedground has been grazed over several times. Likelihood of losses from poisonous plants is reduced. In the morning sheep are extremely hungry and may take otherwise unpalatable plants if they do not have plenty of good forage from which to choose.

Studies in Nevada have shown better daily gains on lambs and 22 percent higher grazing capacity when a 1-night bedding system was used instead of an established bedground.⁹

A 1- to 3-night bedding system requires slightly more frequent moving of the camp and a willing herder. The slight extra expense involved in paying good wages to secure a satisfactory herder, and the added costs of moving camp, are well repaid by greater lamb gains and higher grazing capacity.

⁹ FLEMING, C. E. ONE NIGHT CAMPS VERSUS ESTABLISHED BEDGROUNDS ON NEVADA SHEEP RANGES. Nevada Agr. Expt. Sta. Bul. 103, 21 pp., illus. 1922.

Salt sheep regularly and liberally.—Sheep will make the best use of range forage if for each 100 ewes there is supplied daily 1 to 3 pounds of salt placed in containers. This amount of salt allows for normal waste. Salting every day is preferable, but salt should be given at least once every 3 days. When sheep are not salted for long intervals they grow restless, they may travel excessively, their taste becomes perverted, and they may consume poisonous plants that would otherwise remain untouched.

Develop good facilities for watering sheep.—Ample water at regular intervals is necessary if sheep are to thrive. Furthermore, poorly distributed or inadequate watering facilities limit the grazing use



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FIGURE 13.—The ewes standing up in this picture have bighead caused by eating spineless horsebrush after too rapid trailing. This unpalatable plant is eaten only during excessive hunger such as occurs after trailing too fast or too far or from grazing in early spring before enough forage is available on the range.

of parts of the range and encourage heavy, destructive grazing near the few sources of water available. Trailing long distances to water may also be responsible for sheep eating spineless horsebrush, which causes bighead disease (fig. 13), and perhaps other harmful plants near the watering place. Most poisonous plants are normally eaten but little, but are likely to be taken readily after sheep have trailed long distances and are excessively hungry.

When herds move progressively from one part of the range to another, watering places may be as far apart as 2 miles on range being grazed by ewes and lambs, and not more than 4 miles for dry sheep. This would mean a maximum daily travel of slightly more than 2 miles for ewes and lambs and 4 miles for dry sheep. Even shorter distances are desirable because traveling long distances is detrimental both to the sheep and to the range.

Where watering places are too far apart or poorly spaced, the possibilities of developing additional water supplies through reservoirs, springs, or wells and of hauling water need to be investigated.

The daily water requirement of a ewe with lamb on sagebrush spring range has been found to average slightly less than 1 gallon (0.84 gallon). At the U. S. Sheep Experiment Station the Bureau of Animal Industry found also that the requirement of a dry ewe on dry forage in the fall was 0.75 gallon, and that of a ewe lamb on dry forage in the fall 0.68 gallon.



FIGURE 14.—Firebreaks like this along railroads, highways, or well-traveled roads, and at intervals through spring-fall range will reduce annual loss of forage from fire. Firebreaks are especially needed on cheatgrass range, such as this, to divide the range into blocks so that a fire can be confined to a small area.

Hauling water to the sheep is an excellent practice on ranges where water development is uncertain or costly. Hauling water is frequently not too expensive (10 to 18 cents a sheep month) when viewed in the light of the better distribution of animals, fuller utilization of the range, and superior gains made by the sheep. Ewes and lambs can be on or near fresh forage constantly.

Where adequate permanent sources of water are available it is best to graze (not trail) the sheep to the water, and after they have drunk, graze them to another area or back to the first one. By careful planning the herder can ordinarily direct the travel of the herd so that it will reach water near the middle of the day.

Protect range lands from fire.—On many spring-fall ranges, especially cheatgrass ranges, the hazard of loss from accidental fire should be reduced. Loss of the dried herbage itself is usually less serious than such effects as exposure of the soil to wind erosion, injury to perennials, and the likelihood of decreased forage production the following year. Where the hazard of accidental fire is high, it is profit-

able to put firebreaks along railroads, highways, well-traveled roads, and at intervals on the range (fig. 14), either to keep accidental fires from entering the range or to confine them to smaller areas. Firebreaks may consist of graded strips used for roads, of disked strips, or of wide strips reseeded to crested wheatgrass. The latter may be effective along railroads, highways, or well-traveled roads to keep small fires from entering the range. On sloping land, firebreaks should be seeded to perennial grass to reduce danger of erosion.

CHECKING GRAZING MANAGEMENT AND MAKING ADJUSTMENTS

The success of any grazing program can best be determined by on-the-ground checks of the nature and amount of grazing use, and the relative productivity and trend of the range. It is well to record data separately for the different parts of the range in order that uniformity of grazing use may be checked. Where an examination of the entire range is not feasible, the gentler slopes, areas near water, and other parts where grazing use is likely to be heavy should be examined. If those key parts of the range are being grazed properly, management of the entire range is likely to be satisfactory. But where inspection is usually confined to key areas, all of the range should be inspected at longer intervals to obtain a range-wide appraisal of utilization and the distribution of grazing.

Grazing use may result in maintenance of range condition or it may cause an upward or a downward trend, depending upon the intensity of herbage utilization and the accompanying trampling of the soil during a period of 1, 2, or several years. Nature and intensity of current grazing can be determined by examining the range, or selected parts of it, and estimating the percentage of current plant growth available to sheep that is left ungrazed. Past grazing use can also be evaluated at the same time by checking the indicators of range trend. The average percentage of ungrazed herbage, listed by species, for various parts of the range and for the range as a whole should be compared with what is required to maintain or improve the range. If the most desirable perennial species have disappeared from the range, utilization must be measured by the next most important forage species. Responses to grazing shown by three to eight species, not just one or two, should be observed.

Checking at the end of the spring grazing season gives much more reliable results than checking only in the fall. Since range vegetation is most easily damaged in the spring, it is especially important to determine whether grazing management during that season has been satisfactory. Also, the identification of plant species is easiest before plants dry. Moreover, the amount of ungrazed herbage, especially of highly palatable perennial weeds, can be more accurately observed when the herbage is still green than in the fall after it is dry. Fall observations on grazing use may be very inaccurate because of breakage and loss of dried weed herbage. Inspections at the end of the fall season, however, can provide information useful in appraising the total grazing use.

One must be careful to make proper allowance for differences due to seasons that are much better or poorer than average. What appears to be range betterment in an unusually favorable year may later prove to be merely a temporary increase in plant production resulting from abnormal supplies of moisture. Recurrent overuse of herbage, even though attributable to a series of poor years, is a danger to be guarded against. Utmost care should be taken to detect early signs of permanent downward trend.

Other features of management to be noted, besides condition, trend, and degree of current grazing use, are: Whether spring use began too early, whether bedgrounds were used too many times, and whether portable troughs (where water is being hauled) were left too long in one place. Abnormally compacted soil, badly cut up by trampling, is an indication of grazing that began too early in the spring before the soil had become sufficiently dry to be firm. Excessive use of a bedground is indicated if its location is conspicuous and is surrounded by a wide belt of heavily overgrazed vegetation. Places where portable water troughs remained too long may be marked by wide belts of badly trampled and overgrazed vegetation.

Small areas of range near permanent watering places, shearing corrals, lambing sheds, and sorting corrals are likely to be overgrazed when there is full proper use of the range as a whole. When sheep are watered at streams, wells, or permanently located water troughs, overgrazing of as much as 1 percent of the range area may be unavoidable. Where water is being hauled, very little of the range area need be overgrazed.

Adjustments should be made promptly to correct any unsatisfactory condition of the range caused by too heavy or poorly distributed grazing use or too early spring grazing. Where current grazing use on the range as a whole is consistently too heavy, a reduction of sheep to the number that can be safely carried will pay large dividends. Where the range as a whole is properly stocked but some parts are grazed too heavily and others too lightly as a result of poor distribution of grazing use, better herding practices, more careful planning of sheep movements and the development of additional, well-located watering facilities will permit fuller use of lightly grazed areas and minimize local overgrazing. A downward shift in sheep numbers will give some relief from too early grazing but the best adjustment is to delay the opening of the spring grazing season. If all features of range management, especially rate of stocking, are properly adjusted, spring-fall ranges will provide ample forage in both spring and fall and will contribute fully to efficient lamb and wool production. Sagebrush will not become too dense on the range for easy herding and soil fertility will be maintained or improved.

With continued good range management these benefits can be expected year after year, assuring higher lamb crops, heavier market lambs, and greater wool production—a steady return for the sheepman and a lowered risk to the stability of his operation.

COMMON AND SCIENTIFIC NAMES OF SPECIES MENTIONED

GRASSES AND GRASSLIKE PLANTS

Bluegrass, Nevada	<i>Poa nevadensis</i> .
Bluegrass, Sandberg	<i>Poa secunda</i> .
Cheatgrass (cheatgrass brome, broncoglass)	<i>Bromus tectorum</i> .
Fescues	<i>Festuca</i> spp.
Junegrass, prairie	<i>Koeleria cristata</i> .
Needlegrasses	<i>Stipa</i> spp.
Needle-and-thread	<i>Stipa comata</i> .
Ricegrass, Indian	<i>Oryzopsis hymenoides</i> .
Rye	<i>Secale cereale</i> .
Sedge, threadleaf	<i>Carex filifolia</i> .
Squirreltail, bottlebrush	<i>Sitanion hystrix</i> .
Wheatgrass, bluebunch	<i>Agropyron spicatum</i> and <i>A. inerme</i> . ¹⁰
Wheatgrass, bluestem ¹¹	<i>Agropyron smithii</i> , <i>A. riparium</i> , and <i>A. dasystachyum</i> .
Wheatgrass, crested	<i>Agropyron cristatum</i> .
Wildrye, giant	<i>Elymus condensatus</i> .

WEEDS

Balsamroots	<i>Balsamorhiza</i> spp.
Balsamroot, arrowleaf	<i>Balsamorhiza sagittata</i> .
Buttercups	<i>Ranunculus</i> spp.
Deathcamases	<i>Zigadenus</i> spp.
Hawksbeard, tapertip	<i>Crepis acuminata</i> .
Lomatiums	<i>Lomatium</i> spp.
Lupines	<i>Lupinus</i> spp.
Lupine, tailcup	<i>Lupinus caudatus</i> .
Onion, wild	<i>Allium</i> spp.
Penstemon, royal	<i>Penstemon speciosus</i> .
Phloxes	<i>Phlox</i> spp.
Russianthistle, tumbling	<i>Salsola kali tenuifolia</i> .
Stickseeds	<i>Lappula</i> spp.
Tansymustards	<i>Descurainia</i> spp.
Tumblemustard	<i>Sisymbrium altissimum</i> .
Violets	<i>Viola</i> spp. (chiefly <i>V. beckwithii</i>).
Woodland stars	<i>Lithophragma</i> spp.

SHRUBS

Bitterbrush	<i>Purshia tridentata</i> .
Horsebrush, spineless	<i>Tetradymia canescens inermis</i> .
Rabbitbrushes	<i>Chrysothamnus</i> spp.
Sagebrush, big	<i>Artemisia tridentata</i> .
Sagebrush, threetip	<i>Artemisia tripartita</i> .
Snowberry, mountain	<i>Symphoricarpos oreophilus</i> .

¹⁰ When necessary to distinguish between these two closely related species, *A. inerme* is known as beardless bluebunch wheatgrass, and *A. spicatum* as bearded bluebunch wheatgrass.

¹¹ Bluestem wheatgrass is used in this publication as a common term covering all three of these species which for all practical purposes on spring-fall ranges grow and are grazed much the same. Separately, *Agropyron dasystachyum*, *A. riparium*, and *A. smithii* are known, respectively, as thickspike wheatgrass, streambank wheatgrass, and bluestem (or western) wheatgrass.

